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ABSTRACT

This paper addresses the potential influence of current and projected microcomputer technological advances on the profession of school psychology. An overview of the uses and abuses of computers in school psychology is presented, followed by a brief discussion of three general uses of computers in school psychology: the computer as tool, tutor, and tutee. Ideas for innovations made possible by the use of computers in education are explored in a second section including: therapy; collection and storage of behavior intervention data; diagnosis of problems; facilitation of research; cataloging of resources; and development of pre-service and in-service training procedures. Current computer applications in school psychology are outlined and discussed: (1) test administration; (2) test scoring; (3) test analysis; (4) report writing; (5) data management; (6) research and statistics; (7) time management (8) networks; (9) computer-assisted instruction and computer-managed instruction; (10) career guidance; and (11) databases. Potential problems and possibilities for abuse of computer technology within the profession are organized into four classifications: professional status issues; ethical issues; research issues; and theoretical issues. Excerpts of interviews with recognized experts in the field of computers in education are presented at the beginning of each section. A small computer primer, and a glossary of computer terms are appended. (AG)

MEASURING POTENTIAL: USES AND ABUSES OF COMPUTERS IN SCHOOL PSYCHOLOGY

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ABSTRACT

Examination of issues arising from computer applications in school psychology. Discussion covers present and future applications of computers, and identifies potential abuses of computer technology. Appendices include listing of relevant databases, beginning computer primer and glossary, and activities and processing preferences based on whole brain learning theory.

Descriptors: computers, school psychology, computer applications, whole brain learning, databases, abuses of computer applications.

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PREFACE

Political, social, economic and technological changes impact upon education and the school psychology profession. In particular, the rapid growth and implementation of microcomputer technology within the schools has the potential to forge massive change. But will we be left with "a jet engine technology pulling an oxcart profession" (Papert, 1980)?

This paper attempts to measure the potential of current and projected microcomputer technological advances on the profession of school psychology. First, some general definitions of computer applications will be offered. Then ideas for innovations made possible, even demanded, by the capabilities and impact of computers in education will be considered. In essence, we will explore "what could be" and attempt to expand and stimulate thinking about the impact of computers on the practice of school psychology. Current computer applications will then be discussed. Finally, anticipated problems of computer technology applied in the school psychology profession will be addressed.

Some basic knowledge of data processing and computer terminology is assumed. A glossary and computer primer is included for your reference. This paper will attempt to deal with applications in general. For more specific information regarding software development and availability, you are directed to other sources of information. For

example, the National Association of School Psychologists (NASP) has published a national survey of current computer applications and has established a committee to study computer and technological applications in school psychology. A computer users newsletter is also published by NASP. In addition, journal articles in each of the school psychology journals have addressed the topic.

In the course of writing this paper, the authors attended a summer conference sponsored by the University of Oregon; THE COMPUTER: AN EXTENSION OF THE HUMAN MIND. We were able to interview individually several of the conference presentors. With a slight departure from convention, we have included portions of these interviews at the beginning of each section of this paper. We see these people not only as recognized experts in the field of computers in education, but also as individuals who represent the diversity of "people-machine" interfaces currently at work.

INTRODUCTION

> We are in the process of digging ourselves into an anachronism by preserving practices that have no rational basis beyond their historical roots in an earlier period of technological and theoretical development.
> Seymour Papert

DAVID MOURSUND

David Moursund from the University of Oregon is a bit like a country lawyer; his appearance and relaxed demeanor give misleading clues about his knowledge and capability to make a strong point. Lecturing to a crowd of hundreds, his behavior varies little from that noted when he speaks to one or two people. But at both times, his comments carry the weight of well-considered arguments.

At the conference, THE COMPUTER: AN EXTENSION OF THE HUMAN MIND, Dr. Moursund gave his opinion that skill in science and technology will be important in determining how well this nation survives. There is severe worldwide competition in high technology areas, and to compete in the rarified atmosphere requires computer literate children--children who can use the computer as a tool for learning and problem-solving. It requires children who then become high-tech adults. Yet the schools are afraid to sense this, or to move in a technological direction. Previously he discussed the Open University system in England. The government made the commitment to provide exceptionally high quality college courses produced on television. The cost was approximately one million dollars per course. If the U.S. were to make the same commitment and provide the best quality college courses, using television and computer technology, the cost for one thousand courses would be approximately five billion dollars; the equivalent in cost for one aircraft carrier.

The traditional lag between school and the real world increases if we consider two additional factors. First, schools expect teachers to keep up with advances in education with a half-day workshop or one three-hour course taken occasionally. Contrast this approach to big business, which may spend in excess of $1000 a year per employee for inservice training. There is simply not the commitment to keeping highly-trained people on staff.

Secondly, there are so few computer-literate teachers available today that schools are still asking, "What could we do with a computer in the classroom?". To answer that question, Moursund refers to a paraphrase by Seymour Papert, "What would you do with a pencil in the classroom?". As the pencil was an improvement on the stylus, clay tablets and making tallies in the dust, so the computer is an improvement on the pencil. At the point in time when the change was made from writing in the dirt, there were probably educators who thought people's brains would atrophy from not having to rewrite every problem every time it rained; a resistance to technological advancements that we still see today.

Finally, another observation made by Dr. Moursund is that unless educators are computer literate we will continue to rely on experts in other fields to dictate what is appropriate for educational settings.

MEASURING POTENTIAL:
USES AND ABUSES OF COMPUTERS IN SCHOOL PSYCHOLOGY

INTRODUCTION

Computer technology is in its infancy. With the advent of hundreds of integrated circuits on a single silicon chip in the early 1960s and the tremendous expansion of microcomputers beginning in the middle 1970s, computer technology has radically changed the culture that has adapted to it. There is little that we do that is not touched in some way by computers. Education, traditionally slow to adapt to technological changes, has incorporated computers into administrative functions readily. A recent survey found that 67% of the school districts use computers for management purposes and that by 1985 80% of the schools will be using microcomputers for instructional purposes (Haney, 1982). A national survey of school psychologists (McCullough, 1982) also indicated high interest in computer applications in daily practice and in training settings.

One problem of which to be aware as we explore the possibilities of this rapidly changing technology is the tendency for the first usable, but still primitive, product of a new technology to dig itself in. Making choices about how best to use the technology is not always easy because

past choices may often haunt us. As schools acquire Apples, Pets, Ataris or TRS 80s new models appear with newer and better features, new software is released with newer and better programs. But the equipment purchased this year will still be around for years to come, not to be replaced until it is no longer repairable.

In addition, the curriculum and uses designed for the computer may have their basis in an earlier period of technological and theoretical development. A program to teach and provide drill and practice in long division may be written when the computer (or hand calculators) make doing long division with paper and pencil anachronistic. Papert (1980) refers to this as the QWERTY phenomenon. The QWERTY arrangement of keys on the top row of the typewriter has no rational explanation, only a historical one. In the early days of typewriters keys stuck together. So the more frequently used keys were separated. As typewriters improved, this problem no longer existed but QWERTY remained. Studies of other arrangements of keys have shown them to be more efficient. Justifications for the QWERTY arrangement soon become circular and without rational foundation. These justifications illustrate a social process of myth construction that allows us to build a justification for primitivity into any system. As microcomputers are assimilated into schools and into the school psychology profession we have to be on guard against justifying myths with the computer. That is, we should not

preserve practices that have only an historical basis to justify their existence.

In this paper we want to defy the QWERTY phenomenon, to whet your appetite for what could be, to stretch your imagination and creativity. We invite you to go beyond the ideas we present here, to imagine a school psychology profession that uses computers to their ultimate potential as extensions of the human mind.

THE COMPUTER AS A TOOL, TUTOR, AND TUTEE

ALFRED BORK

Alfred Bork certainly gave the impression of a man in charge of technology. Near his podium was a spaghetti-bowl of wires, leading to projection televisions, terminals, and regular video monitors, His statements seemed devoid of those qualifiers that allow experts to wiggle loose from their projections--few "perhaps", "possiblies", and "probablies". Definitely the type of speech to expect from someone who first gathered the data and then drew the conclusions.

The video screen is not a piece of paper, a point he made repeatedly. So the placement of information on a screen should not necessarily resemble a book. In fact, if full use of a computer's graphics capabilities are used, it will probably not call to mind any book yet encountered. To mimic a book is to miss the point.

The two main advantages of computer instruction are that the learning is made active, and the sequence of ideas can be individualized according to the progress of the student. Both of these activities are difficult to achieve in groups much larger than five students. For example, the average time between interactions on the instructional programs assessed at the University of California at Irvine, was 15 seconds. For the students to learn quickly, they have to be taught quickly. With the advent of speech recognition or brain-wave control of computer functions the interaction could increase markedly.

A third advantage, dealt with almost as an aside, was the ability of the computer programs to use many small tests of understanding, rather than a large mid-term plus a final. These tests enable changes in the instruction, plus have the advantage of immediate feedback to the student, thus making the test a learning situation in itself.

One type of learning was clearly advised against, and the cocktail party circuit was forever grateful for this free topic of conversation. BASIC, a common computer language for home computers, was considered by Bork to be the "junk food of programming languages". He cited Edsger Dijkstra's view that anyone having several hours of experience programming in BASIC is "mentally mutilated beyond hope of regeneration"(p. 23). Learning a modern language like PASCAL then becomes unlikely, as if experience with BASIC had been a hammer blow to the head. The readers are encouraged to try this idea at their next party of computer-literate friends...

DEFINITIONS

Some definitions of general uses of computers in school psychology are needed. These uses can be classified into one of three categories: tool, tutor or tutee (Taylor, 1978).

THE COMPUTER AS A TOOL

The computer is programmed to perform useful functions such as word processing, statistical analysis, record keeping, scoring and/or analyzing test results, etc. Routine clerical tasks of a tedious, mechanical nature, tasks done repetitively or frequently, tasks that require complex calculations, or tasks that would take hundreds of hours to perform by hand can be accomplished with a computer in far less time than by conventional methods. Predominantly, current school psychology uses would fall under the TOOL category as the microcomputer is used to assist in routine tasks such as test scoring, test analysis, report writing and data management.

THE COMPUTER AS TUTOR

When used as a TUTOR, educational material is programmed into the computer by "experts" in programming and the subject area. The computer presents the subject

material, the student responds, and the computer evaluates the response. Based on the results of the evaluation, the computer determines what to present next. At its best, the computer tutor keeps complete records on each student being tutored. It has at its disposal a wide range of subject detail to present. It has an extensive, flexible way to test while leading the student through the material. The computer tutor can swiftly tailor the presentation to accommodate a wide range of student differences. When the microcomputer is employed for instructional purposes, as in graduate training programs, it would fall under the TUTOR category. In addition, computer-adapted testing and computer managed instruction falls partially under this category of use. That is, a large body of subject material from an array of subject areas must be programmed before assessment of the subject's mastery of that material can be accomplished. Following identification of the subject's level of mastery in several areas, individualized educational plans can be generated and even implemented by the computer.

THE COMPUTER AS A TUTEE

By necessity, a language must be available that both the computer and the subject "understand". This language is used to teach the computer to carry out an action. This teaching process is called programming. Because the

computer is dumb, patient, rigid and has an unlimited capacity for being initialized and started over from scratch, it makes an excellent "tutee". In order to teach the computer the tutor must (1) understand the subject area that she or he is trying to teach the computer; (2) learn something about how computers work and (3) learn how her or his own thinking works. The implications of this mode of computer usage for school psychology lies in the shift of focus from the end products of learning to the process of learning, from acquiring, remembering and repeating facts to manipulating and understanding them. The implications for the evaluation of learning, assessment of learning potential and the radical changes in the development of thinking skills in children exposed to computer programming from a very early age may provoke major changes in the theories and practice of school psychology.

IDEAS...TAKE THESE AND GO FARTHER

FUTURE COMPUTER APPLICATIONS

> I believe that the computer presence will enable us to so modify the learning environment outside the classrooms that much if not all the knowledge schools presently try to teach with such pain and expense and such limited success will be learned, as the child learns to talk, painlessly, successfully and without organized instruction. This obviously implies that schools as we know them today will have no place in the future. But it is an open question whether they will adapt by transforming themselves into something new or wither away and be replaced.
>
> Seymour Papert

RAMON ZAMORA

"The schools don't have to be in a particular place." The end of a long day, the last of the conference series, and Ramon Zamora still has the energy for one final interview. As he talks, his enthusiasm begins to leak out, first around the edges of his smile, later in hand gestures. His experience with ComputerTown,USA, where computers are placed to give people maximium exposure to the computer systems, causes him to dream in terms of what he calls the four A's: an environment where Anybody can learn Anything, Anytime, Anywhere.

It is difficult not to get caught up in his Third Wave visions. By connecting home computer systems to large databases, by networking with others of similar interests, who needs a large, centralized school? Most of what is now considered to be school-type learning could take place at home, or with a close friend. Schools in their current incarnations are likely to work harder and harder to do less and less of any value. With the exception of certain social functions, monolithic public schooling is seen as fading for all but the severely disadvantaged or handicapped for whom small computers may remain inaffordable or inaccessible.

The plan appears to be fantastic and improbable from the outset. Yet the technology is available now. People who once doubted their ability to cope with computers find that they too, can become quick keyboard jockies with just a short exposure to the machinery. Why not begin?

Needless to say, more than a few school psychologists are having trouble envisioning their place in a decentralized school system. It is difficult to be enthusiastic about a future in which one does not seem to be included! Pausing for a moment, Ramon projects a need for psychologists, but not hired by the school. Instead, he suggested that school psychologists might shift their emphasis to discovering the important factors that

facilitate learning from an interactive computer system, encourage community cooperation, and generally build a healthy learning environment for people. Such "community learning" psychologists would work for the local community, helping to meet community needs. The advent of the free-lance community learning psychologists may be near.

FUTURE COMPUTER APPLICATIONS

Making projections about the future of computers in school psychology is dangerous business. Computer technology is changing so rapidly even the computer scientists cannot keep up. It follows there is necessarily a developmental delay in software development. Thus, some of the applications described in this section have not been developed yet. The technology is available to do so, however. Other applications may be available but are not widely publicized or are not being published by their authors for a variety of reasons. Also, the following projections do not begin to exhaust the possibilities for the development of software and computer technology within the field of school psychology. We have attempted to provide a data base -- a beginning designed to stretch the imagination and creativity of the school psychology computer enthusiasts.

POTENTIALITIES

1. Use computers and specialized computer programs as a form of therapy. Behaviorally deficient children could experiment with different solutions to problems and immediately experience the consequences of their choices

through computer simulations. For example, using videodisk-computer combinations common problem situations could be presented to the child. The child could decide the characters-ages, sex, race; setting, and problem situation. The computer would generate a scenario and interact with the child about possible solutions. The consequences of various choices would be presented. Use of videodisk technology would allow interactive role playing in a secure, private setting. Such a program would become an interactive computer soap opera of sorts, with actors and actresses performing in situations which are directly related to the problems faced by the child. Such programs might also be used to teach social skills to handicapped children or to younger children.

2. Collect and store behavior intervention data with data management programs. Then use the data to look at trait/intervention interactions. That is, use the information to help us predict what instruction will be beneficial to what children under what conditions. With the data readily accessible and easily organized in a variety of ways, school records can be put to better uses than filling filing cabinets or gracing yearly reports.

For example, drawing from aptitude-treatment interaction research (ATI) we could make predictions and plan interventions to make the best use of a child's strengths. We would have a data base to give us information

about which interventions worked or did not work well in similar cases.

3. Use computers to help children learn subtle rule systems. When we do not follow the rules (such as giving an erroneous input message to the computer) we get error messages back and the system does not follow our directions. Children can generalize this understanding to the larger world of social system rules. Computers also quickly teach children to break systems down into smaller chunks in order to understand them. Problem solving strategies needed to solve computer "bugs" can be transferred to solving other life problems. One of the most important lessons learned from the computer is that it is alright to make a mistake. We learn from our mistakes. Computer program "bugs" have to be "debugged" before we can get the program to run properly. And, computer programs ALWAYS have "bugs" at first. Thus, practice using problem solving strategies is relevant and naturally rewarding.

4. Program computers to help analyze/diagnose problems. For instance, the medical profession uses computers to do intake interviews, to ascertain background information, medical history, etc. The computer follows up responses to the questions with other questions. The physician then receives a tentative diagnosis or recommendations of tests to give or further information to

ascertain such as blood pressure, heart rate, etc. Studies have shown that people tend to be more honest when responding to computer questions than to an interviewer, no matter how sympathetic or experienced the interviewer may be (Evans, 1979). Using the computer to gain important background information from both parents and teachers could be not only a time-saver but a better source of information than current methods. Structured questions could elicit behavioral and academic information directly relevant to the reason for referral and aid in planning appropriate consultative or intervention techniques.

5. Establish a database from practitioner's data that would describe children's behavior in different crisis situations. For instance, factors that seem most closely associated with separation anxiety or factors that emerge strongly in regards to school phobics could be culled from practitioners. Typical ages for universal crises--such as rejection by the best friend could be determined. Through parent training, individual or small group interventions we could prepare for these problems in advance, possibly avoiding the anticipated crisis altogether.

6. Facilitate descriptive and longitudinal research by practitioners with microcomputers that can store and manipulate large amounts of data. We expect increased development of local norms, and local profiles for learning

disabled children. Identification of consistent problem areas in instruction and trends within local populations would be almost instantly possible with computerized databases.

7. Produce intervention effectiveness data that would be available to increase accuracy of recommended educational changes. For instance, the school psychologist could describe a problem behavior to the computer. The computer would then draw on its database to describe some possible intervention strategies along with the expected percentage rate of success. The school psychologist could then suggest strategies to the teachers/parents with the additional information that Plan A has an 80% chance of success, Plan B has a 40% chance of success and Plan C has not been tried before. Computers could allow us to support our recommendations with research-based information, unlike current practice.

8. Catalog the numerous resources that are often hidden away in the teacher's closets or are only used infrequently within a school district. A computerized listing of all the resources of the district, their location and projected usage schedule could more effectively distribute those resources among all the teachers and school psychologists who might have need for them. Thus, if a school psychologist recommended a certain remediation

strategy, information would be readily available as to whether the needed materials were available and where to find them.

9. Increase communication among education professionals with computer telecommunication networks such as Special Net or in-state education networks. These networks offer public bulletin boards where announcements of classes, workshops, seminars, meetings of all kinds are announced. The bulletin boards may also contain notices of unlimited variety. For instance, a computer bulletin board might contain the following: (1) an offer to exchange a spelling program for a math program; (2) someone might be looking for help with a particular programming bug; (3) a users group might be announcing an event; or (4) a researcher might be looking for subjects for a computer study. A Federal bulletin board would contain up to the minute information on legal changes or announcements at the national level. State legislative bulletin boards would contain equivalent information at the state level. School psychology bulletin boards could contain (1) information to share about new, useful materials; (2) questions about a complex instructional problem; or (3) exchanges of information about a child transferring from one district to another, etc. Through Special Net a school psychologist with a concern about a multi-handicapped child could gain information about the latest research findings, suggestions

for evaluation and remediation, and names of people to contact for further information.

Telecommunication networks also open up the limitless possibilities of electronic mail. Information is transmitted instantly. Documents can be shared without ever seeing paper, envelopes or stamps. Communication among and between school psychologists could be greatly facilitated.

Telecommunication networks also offer the possibility of transmitting entire newsletters, journals, any kind of written communication over modem interfaces (telephone hookups) to computer receivers. Mailboxes may be found in antique shops one day rather than next to the front door.

10. Assess the impact of Computer Adapted Testing (CAT), an individually tailored evaluation system (under development now at Educational Testing Service). A flexible number of items are selected from a large item pool to maximize matching of new items to the child's ability level as measured by preceding items. In essence, CAT is criterion referenced testing carried to its ultimate potential. At any point in time the achievement level of a child can be measured and compared to that child's previous achievement level. Since each test is unique to the child taking the test, no two tests will be alike. Thus, classical test theory which emphasizes reliability, validity and estimation of true scores based on the total score for a test must be thrown out and replaced by Item Characteristic

Curve Theory (Tatsuoka and Birenbaum, 1981).

With computers in every classroom computer adapted testing could be accomplished as frequently or infrequently as necessary. Knowing the child's level of achievement across several subject areas would immediately pinpoint where instruction should begin. Deficits or knowledge gaps would be apparent and individualized instruction planned.

Computer Managed Instruction (CMI), a related system, keeps track of errors as the child attempts a computer assisted instructional program. It keeps records for the teacher on the number and type of errors. It notifies the child of the same information, if desired. In addition, it can automatically provide additional practice over those items that were missed during instruction.

With both computer adapted testing and computer managed instruction, the teacher can know exactly where the child is functioning and what areas of weakness need remediation. Once the classroom teacher has access to this information the question then becomes "What does the school psychologist do?

11. Incorporate "whole-brain", "no limits to learning" theory into assessment and remediation strategies (Torrance, 1981). Using traditional or computer assisted evaluation to determine hemisphericity (learning style) we could then individualize instructional strategies using microcomputers. Appendix A contains a list of specialized information

processing preferences that have been associated with either right or left hemisphere functioning. Compare this listing with the list of possible computer applications (Appendix B) offered by a group of Georgia elementary gifted children. They were asked what to recommend if the schools were closed because every home had a microcomputer and all teaching was to be done by computers. The children were specifically asked to think of activities that would keep the attention of children and avoid declining achievement scores.

Torrance (1981) points out that

> ...the weight of present evidence indicates that people fundamentally prefer to learn in creative ways -- by exploring, manipulating, questioning, experimenting, risking, testing and modifying ideas....Current and traditional public school teaching strategies appeal to and develop primarily the left cerebral hemisphere through their heavy emphasis on language processes and on the logical, sequential processing of information. ... It is possible to modify a person's preferred style of learning and thinking over relatively brief periods of time (six to ten weeks). Not only are changes possible, but it seems that the general direction of the changes can also be controlled....It may become possible to train individuals to modify their information processing procedures to best fit the demands of their lives. (p. 101)

Following is a brief description of how computers are being used now with a comparison to theories of whole-brained learning and thinking.

(a) Drill and Practice

Computers become an "electronic workbook" to provide practice and reinforce concepts previously taught. Drill and practice may elicit either left or right cerebral

hemisphere responses depending on how it is conducted. If it emphasizes factual detail, and calls for verbal responses it probably uses left hemisphere functions. If it emphasizes the "big ideas" of the content area, involves imagery and visualization, it probably requires right hemisphere functions.

(b) Tutoring

Computers sytematically present new information with branching options depending on the child's responses. This procedure emphasizes right hemisphere functioning. However, if logical, linear, sequential processing is emphasized, it would call for left hemisphere processing.

(c) Simulations and Games

Students are presented with alternatives by the computer and manipulate certain variables to produce desired outcomes. Both left and right hemisphere functions are used when students predict, estimate, judge the reasonableness of an answer and perhaps work with graphs, charts, and pictures.

(d) Information Retrieval

Information retrieval as part of computer assisted instruction is generally associated with left hemisphere functioning. However, it depends on how the information is presented and how it is processed after it is received.

(e) Problem Solving

Using the computer as a powerful calculator or a creative medium for developing programs of various kinds can provide practice in integrated whole-brained functioning.

12. Assess individual differences in acquisition and retention of new knowledge, that is, focus on process variables rather than product variables (Mitzel, 1981). For instance, computer simulations could assess (A) rate to mastery under a variety of conditions; (B) preferred modality; (C) hemisphericity; or (D) motivational factors. This information could then be used to plan individualized educational programs or behavioral interventions.

13. Develop new pre-service and in-service training procedures. Our present school psychology training procedures consist of trial and error procedures with real subjects in which (A) the subjects are not always available when needed; (B) the type of problem presented is unpredictable; (C) it is difficult to check procedures and diagnoses; and (D) incorrect diagnoses are possible at the expense of the subject. Computer simulations could be developed which not only could present realistic situations but could also "change" subject behavior to simulate the impact of the decisions made (Boysen and Thomas, 1979).

Thus, simulations of problem behaviors or problem classroom settings could be programmed. The student would indicate the appropriate intervention strategy and receive immediate feedback on the effect of that strategy on the simulated problem. In assessment practicums (assuming we still need them in the face of computer technology) similar simulations would have the computer act as a subject of a

given ability level and a given age and produce responses for the student to evaluate. Immediate feedback could be available on the correctness of the student's choice.

Inservice training or continuing professional development courses could be offered using these same training materials. Using modem interfaces in the comfort of one's home or office or in onsite training workshops the practitioner could learn new techniques, new intervention strategies, retool on revised or new evaluation procedures, practice on the computer simulations and then pass a mastery test. CPD credits could be arranged for successful completion of the materials. Such arrangements are already in place within the medical profession.

14. Combine videodisk and computer technology. Combining these two mediums gives one the power of television and the ability to use real people doing real things rather than animated simulations on computers. Combining the computer with the videodisk gives a formerly passive medium an interactive capability. In essence, the TV program can be stopped, modified, changed, questioned, begun over again or skipped over to another section. Branching programs are possible to make the instruction individualized. Videodisk-computer programs have been developed for use with deaf children and have been found to be an effective teaching medium (Thorkildsen, 1982). Possible uses for school psychologists include:

(A) consulting/counseling training, teaching interviewing skills;

(B) counseling therapy, interactive role playing of problem situations with immediate feedback on the effects of proposed solutions to the problems;

(C) parent training, interactive role playing and solution try-out;

(D) pre-service and in-service training, simulations of problem situations and achievement of mastery in assessment skills;

(E) instructional interventions, especially for children requiring emphasis on visual or multi-modal presentation of material or numerous repetitions of a highly motivating nature; and

(F) teach and test assessment possible as a means to assess learning strengths and weaknesses.

15. Employ large commercial databases effectively. Appendix C contains a listing of large databases that are currently available and being added to daily. One point to keep in mind is that the information contained in these databases may not be as up to date as desired. Much of the information in them has come from journal articles and other published material. Often there is one to two year lags between the research and the time it is published. By the time it reaches the database it may be two or three years old. Some large databases do contain more up-to-date

information. However, bulletin boards on national telecommunication networks may be a more current source of research information.

A caution is in order. In libraries are people who are skilled in interacting with the different databases. Use them. The number of times access to a large database is needed is limited, probably less than once or twice a year, if that much. It takes training and practice to know how to efficiently enter the appropriate descriptors to get the output desired. Access time on the databases is expensive (usually above $30 per hour). Wasting time and energy and getting expensive computer garbage as output is a very frustrating experience.

Fifteen suggestions for future computer applications in school psychology do not exhaust the possibilities for the field. These ideas have been offered as starting points. School psychology as we know it today may not exist in the future. Computer technology can help to expand our roles within the schools and the community as we either "adapt by transforming (ourselves) into something new or wither away and be replaced" (Papert, 1981).

In the following section, current applications of computers in school psychology will be explored.

CURRENT COMPUTER APPLICATIONS

> We are at a point in the history of education when radical change is possible, and the possibility for that change is directly tied to the impact of the computer...Increasingly, the computers of the very near future will be the private property of individuals, and this will gradually return to the individual the power to determine patterns of education...There will be new opportunities for imagination and originality. There might be a renaissance of thinking about education.
>
> Seymour Papert

HAROLD KINNE

Harold Kinne, from the University of Texas at Dallas, was a good choice for a luncheon speaker. His topic, "Microcomputer Technology, Past, Present, and Future", seemed appropriate for a gentleman who has literally grown up with technology and has a penchant for electronic gadgets. A voice from a coat pocket announces the time with a mechanical tone; his regular wristwatch is used for calculations. From another pocket, he pulls a small, wooden object that he bought at the nearby market, and asks an adult to identify the hand-carved whatzit.

"Most intelligent adults will do what you have just done," he observed. There was a judging of the weight, a turning over, and a quizzical look as the use of the object went undetermined. Kinne then pointed out that when an unusual device is presented to most children of today, they first look for the on/off switch. Failing to find that, they assume that the batteries are dead. This is the problem facing the school today--the students know more about new technology than the teachers. Indeed, most educators are scrambling to catch up.

The first requirement in the adjustment to new technology is involvement. According to Kinne, educators must first sense a personal involvement or they will not invest the time to learn how to use small computers. Even a tiny, function-limited, $100 computer is sufficient to provide the initial contact and spark the enthusiasm. After that contact, teachers can go on to larger systems.
What are the advantages of computers in the classroom? Two come to mind quickly. First, it can be used to amplify the intelligence of the user. Secondly, the machinery is consistent and neutral, factors enjoyed by many people but found in few locations on this planet. Could experience with a consistent neutral learning device help people develop the confidance to deal with a variable world?

Perhaps. As Harold recalled, at least one student enjoys lessons on the school computer because the computer doesn't know the child is black.

CURRENT COMPUTER APPLICATIONS

Currently available school psychology computer applications reflect the needs of the field practitioner. Predominantly, the software fills needs related to evaluation procedures including test administration, test scoring, test analysis, report writing and data management. In daily practice heavily influenced by the evaluation demands of PL 94-142, software that provides help with these tasks can increase (1) efficiency, (2) scoring accuracy, (3) standardization of test interpretation; and decrease (1) scoring errors, (2) scoring time, (3) report writing time, and (4) interpretive misjudgements. Following are descriptions of current applications. There is an obvious contrast between this description of "what is" and the preceeding section on "what could be" This section describes where we are now. Where we go tomorrow depends on the informed choices we make today.

TEST ADMINISTRATION

Few standardized tests that are used with school-aged children are currently available for computerized administration. However, criterion referenced and teacher

prepared tests directly related to computer-assisted instructional programs are prolific and readily available. Other programs are available to help create, administer, score and maintain records of teacher-made tests (Kamins, 1981). Such programs allow the student to take tests with corrective feedback or use them as instructional programs. Using the test as an instructional aid the student gets three chances to answer correctly, receiving feedback on each response and finally receiving the correct answer if needed. The program keeps track of errors, notes the nature of the error and stores this information for later use by the student and the teacher.

One unique program under development (Ray, 1982) is a computerized WISC-R protocol. Rather than write the child's responses on the protocol, the answers are entered directly into the computer. Each response can be scored immediately or delayed until later. The program offers prompts for determining basal and ceiling levels. At the conclusion of the testing session the computer will produce the standard scores.

Most computer-administered tests are for adult populations. They include personality inventories, and vocational or interest inventories. There is hardware available that is specifically designed for test-taking. The keyboards have been modified so that there are just a few keys to minimize confusion. Tests that are in a multiple choice or forced choice format are readily adapted

to computerized administration.

Test administration is a controversial area in school psychology computer applications. Some practitioners view computerized test administration as a threat to job security rather than as an opportunity to enlarge the possibilities for service delivery. Research is needed to determine the reality of this perceived threat. Research is also needed to identify differences between computer administered tests and practitioner administered tests. Studies have shown people to be more open and honest when responding to computer questions than when responding to a human interviewer (Evans, 1979). Whether the computer would be a distracting and interfering factor or an enhancing one remains to be shown.

TEST SCORING

Test scoring appears to be an area where school psychologists have worked on developing their programming skills. Several practitioners reported writing their own scoring programs for tests they use frequently (McCullough, 1982). These programs are not for sale and have been for the sole use of their developers. A quick look at test catalogues shows there is a growing number of test scoring programs available for the WISC-R and the Woodcock-Johnson Psychoeducational Battery.

Test scoring programs depend on the examiner to type in

raw data. Thus, individual subtests would have to be scored in the traditional manner. The computer then displays the standardized scores accurately and in seconds. In some cases, the standard scores are accompanied by a written analysis of the scores. In other cases, a description of what the test measures is accompanied by a discussion of subject performance as compared to the norm group and as compared to him/herself.

Quality varies considerably among test scoring programs and one is advised to obtain a representative printout of the program before purchasing. One scoring program was designed to destroy itself after a certain number of tests had been scored. This forced the user to return for another disk. Apparently few people bought this over-priced service. Unlimited scoring disks are now being marketed by this company. Buyer beware is the best advice we can give. It is also not a bad idea to check the program for accuracy in scoring. When large numbers of tables have to be entered into a program there is always room for typing errors. Bugs in computer programs are legend! (If such a bug is discovered, notify the seller/developer. Bugs can be fixed once they are found.)

TEST ANALYSIS

Test analysis programs have also been produced by school psychologists for their own personal use (McCullough,

1982). These programs usually have a particular theoretical orientation that is used to analyze data from a specific test or tests. For example, WISC-R analyses are available using the Sattler, Kaufman, Lutey and a statistical method of interpretation. Several of these are now becoming commercially available (McCullough, 1982). Again, quality varies on organization, print format and various content factors. We suggest potential users obtain a printout of a sample analysis before purchasing the program to see if the theoretical orientation and the programmer's interpretation of that orientation agrees with yours. You might not be happy with the results otherwise.

These programs can be used as screen or hardcopy programs, that is, the analysis can be read on the video monitor or printed on paper. Some of the programs tend to be detailed and wordy. Practitioners vary in their reports of how much these programs are used (McCullough, 1982). For some practitioners already familiar with that particular analysis the program might be referred to infrequently. However, the program could prove valuable for an unusual profile or a need to review a particular interpretation. Other practitioners reported that the programs were used for nearly every analysis.

The use of test analysis programs is recommended for preservice or inservice training. Practice in interpreting various profiles would be possible. Since professional skills tend to slip a bit as the years go by these programs

could serve well as a continuing professioal development exercise.

REPORT WRITING

Report writing software is available in three types: (1) word processors (2) personalized report writers and (3) report generators.

Word processors or text editors abound in the market place. There are several kinds for each microcomputer. Cost and capability are closely related. Comparison shopping for "best buys" is advised. Word processors make writing effortless (almost). For report writing purposes, a simple program is adequate. However, there are more complex programs with built in dictionaries that find spelling errors and correct them. Word processing programs may not interest those who are not used to composing reports at a keyboard or who enjoy the status of having a secretary. However, typewriters tend to start gathering dust once a word processor is used.

With the ease of revision afforded by word processors the way we think when we write is altered. They have been shown to change the way children write and to change children's attitudes towards writing (Papert, 1981). Word processors allow limitless freedom to change, edit, erase or start over. A user can work on any section, move paragraphs around or do the introduction section last; all without

putting anything on paper until it is just right.

Personalized report writers use word processing programs especially designed to make psychological report writing more efficient. Typically, these programs contain a means to insert certain phrases that are used frequently. For instance, if a section of the report describes the evaluation procedures used, this section is probably repeated in every report. To reduce this repetition, the user stores the often repeated portion on a disk. Then when a report is written the user issues a command that tells the computer which prearranged phrases to pull. The computer will insert those phrases into the designated section of the report. Some school psychologists have stored lists of recommendations that they frequently give, for instance, a description of a cognitive behavior modification technique. Then, instead of describing this technique each time, the computer does it. By using such word processing programs, most of the practitioner's time can be spent on the portions of the report that are unique to the referral.

Personalized report writing programs can be genuine time-savers for practitioners who must prepare their own reports. Again, these are practitioner-developed programs and few are available commercially. The quality will vary and again, potential users should obtain a demonstration and printout of the program prior to purchase.

The third type of report writer, a report generator, is a depersonalized compilation of data, a report of scores.

Frequently, the data is presented in charts or graphs. No attempt is made to interpret the data or to account for behavioral or motivational influences on the scores. Only cursury descriptions of test results may appear. Frequently these report formats are part of larger programs, such as IEP development or maintenance programs. If this type of reporting of evaluation information is the only type available it would appear to be in violation of ethical standards.

DATA MANAGEMENT

Data management or record keeping software has wide use and acceptance by educational administrators, teachers and school psychologists. Data can be compressed and stored electronically in larger quantities. An entire library could be stored in a space about the size of one of today's paperback books (Evans, 1979).

Commercially available database software can be adapted to a variety of specialized uses for school psychologists. Such software allows the user to define what kind of files are going to be stored and how the files will be organized. In essence, a personalized filing system is being established. The uniqueness of the computerized filing system lies not only in its storage capacity, but in what can be done to the data once it is in the files. Files can be indexed in any manner desired, e.g. alphabetically, by

zip code or other code, by some defined classification, etc. Any numerical data contained in the files can be manipulated by the user (within the limits of the database program in use). For instance, means, standard deviations, or other statistical operations can be done with the data. When information is added to already existing files, the computer automatically updates these indexes or mathematical operations if so desired.

Thus, for school psychologists a typical file might contain information on clients, various therapeutic interventions, behavioral intervention data, or evaluation data. The practitioner would have instant access to any file and could easily update, delete, or reorganize the data contained within them. For instance, perhaps the school psychologist would like to see if there are any patterns emerging with children identified as learning disabled at a particular school or grade level. The database program would search through the files and produce such information in a few seconds.

One use of data management programs has been in the monitoring of behavioral intervention data (Grimes and Ross-Reynolds, 1981). The effectiveness of intervention data is immediately available. Further, the program can be designed to provide reminders to check on interventions that are in progress. The school psychologist would then know the behavior level as of the last check, what intervention was in progress, and the nature of the referring problem.

When several interventions are being monitored simultaneously such information can be useful.

Other uses for data management programs include maintaining inventory records or creating and maintaining IEP records. Whatever information needs to be stored and accessed, maintained, modified, updated, indexed, sorted into different categories or placed into any kind of a report can be managed by a data management program.

Comparison shopping is again recommended. Each microcomputer has several database programs available for it. They vary in how big files can be, how easy it is to update files, and the kind of arithmetic operations it is possible to do with the data. Template programs have been designed by some school psychologists to accompany some of the more common database programs that are available commercially.

RESEARCH AND STATISTICS

Main frame computers were used for research purposes in education long before the advent of microcomputers. With microcomputers many of the capabilities of the large computers are now available to practitioners. Statistical packages are available for the various microcomputers. They vary in content and quality. Again, many school psychology computer users have developed statistical programs to fit their own needs. Some commercially

available programs, such as Visicalc or Supercalc allow complex manipulation of data and also have predictive capabilities. For large amounts of data, main frame computers are still the first choice.

Microcomputers open up the world of research to practitioners. When database programs are used to store data, it is relatively easy to sort the data along differing classifications. A descriptive study emerges rather easily. Experimental research is also facilitated by microcomputer technology. Microcomputers can be used to present various kinds of stimuli and to collect response data. Given appropriate software, analysis of the data easily follows.

TIME MANAGEMENT

Some administrators want to know how school psychologists spend their time. Time management programs assist in this process. Data can either be entered directly into the computer or put on coded cards for a clerk to enter. Categories of tasks related to the school psychologist's job description are determined, such as consulting with teachers, testing, observing, etc. Then amounts of time spent in each task can be noted. The reports generated by the computer can then be easily accessed by an administrator. Specific programs are available to do this task but database programs could also be used (McCullough, 1982).

NETWORKS

Large computer telecommunication networks provide current information and instant communication among users. To use the network access to either a computer terminal, microcomputer or word processor with telephone communication capabilities is needed. By dialing a local or "800" number a direct connection to a computer is established which then allows messages to be sent or received. Networks include the following services: (1) electronic mail - personal correspondence between individuals and groups; (2) electronic bulletin boards - up-to-the-minute information on key topics of interest to users; (3) data collection and information management systems - computer-based tools for conducting surveys and storing/analyzing informaion.

One network of interest to school psychologists is SpecialNet established by the National Association of State Directors of Special Edcuation (NASDE). Subscribers to SpecialNet include a nationwide network of educators, resource organizations, advocacy groups, parents and others interested in special education. SpecialNet has numerous bulletin boards including:

1. FEDERAL - daily updates on activities in Washington DC that impact on special education (maintained by NASDE);
2. LITIGATION - brief descriptions of court cases

and hearing decisions with references to assist the reader in obtaining indepth information on particular cases (maintained by Education for the Handicapped Law Report, EHLR);

3. RFP - a listing of requests for proposals and grants that relate to special education (maintained by NASDE);

4. EARLYCHILDHOOD - information pertaining to services for handicapped children from 0-8 years of age; subscribers post messages on this board;

5. EMPLOYMENT - listing of employment opportunities in special education; any subscriber can send employment announcements to this bulletin board;

6. CONFERENCE - listing of special education related conferences; any subscriber can post an announcement;

7. MULTIHANDICAPPED - information on administrative and instructional services for severely and multiply handicapped students (maintained by the Teaching Research Division of the Oregon State System of Higher Education);

8. COMPUTER - information on computer applications in special education (maintained by Education Turnkey Systems, Falls Church, Va. though any subscriber can also send a message to this board);

9. PRACTICES - promising practices from around the nation regarding the provision of services for handicapped students are described; any subscriber can submit information;

10. POLICY - designed to assist State and Local Education Agencies in developing or revising policies related to PL 94-142 and Section 504; information is provided by Long and Silverstein, P.C., a Washington, D.C. law firm; (NASDE, 1982).

The above is a partial listing of the bulletin boards available on SpecialNet. Recently, NASP joined the network and will be establishing school psychology bulletin boards. Bulletin boards contain public information. For private messages or correspondence the electronic mail capabilities are used. SpecialNet may cost less than conventional mail or long distance telephone calls depending on its usage. It is possible to print out the information received or to view it on the screen. There is a subscription fee to join, plus telephone connect charges for each use. For further information, contact

National Association of
State Directors of Special Education
1201 16th Street, N.W., Suite 404E
Washington, DC 20036
Telephone (202) 822-7933

Other networks are also available with similar capabilities and new ones may emerge from other national organizations such as the American Psycholoical Association. For now, SpecialNet appears to meet some of the needs of school psychologists especially now that NASP has become a

subscriber and contributor. Since school psychologists also have ties to regular education and psychology, other networks established within those fields will also be of value.

Several state educational agencies have established their own intrastate networks. These include Illinois, Oregon, South Carolina, Pennsylvannia, California, Minnesota, Wisconsin, Kansas, Florida, and Utah. These state networks offer many of the same services as the national networks, that is, electronic mail and bulletin boards. In addition, through these state networks the large database organizations can be accessed and searched for specific information. For example, the Illinois Resource and Dissemination Network (IRDN), supplies Illinois educators with education literature, projects, programs and consultants. IRDN includes a Promising Practices File(PPF) and Human Resources File(HRF). The PLATO system is used for searching state resources files online. Also, IRDN uses databases from Lockheed/DIALOG and Bibliographic Reference Service (BRS) (see Appendix C for description of these large database files). Another use of the state networks is record keeping functions. When the Local Education Agencies store their required student data on computers, the necessary state reports are easily sorted and filed over the state computer network. Savings in time and paperwork are great (NASDE, 1981).

Still another use for the state networks is that

pioneered by the Minnesota Educational Computing Consortium (MECC). MECC is a statewide instructional time-sharing network which serves as a tool for classroom instruction. No need for each school district to invest in software that is also used throughout the state. Through time-sharing on the MECC system each school has access to over 950 programs that are in the system. Apple or Atari computers with modems are in most classrooms throughout the state.

COMPUTER ASSISTED INSTRUCTION
COMPUTER MANAGED INSTRUCTION

It is beyond the scope of this paper to detail the wide variety of instructional software that is available. Numerous reviews are available in such publications as The Computing Teacher or Journal of Computer-based Instruction. Local, regional and state workshops on computer-assisted instruction are occurring nationwide.

Guidelines for evaluation of instructional software are also available from:

International Consortium of Computer Educators (ICCE)
Department of Computer and Information Science
University of Oregon
Eugene, OR 97405

Since computer assisted instruction (CAI) appears to have the potential to encourage individualized instruction, school psychologists would be well advised to become knowledgable about the possibilities offered in this area. Computer-assisted programs could be incorporated into instructional recommendations for remediating learning

problems especially as more research emerges to determine their usefulness. The earlier discussion on "whole-brain" research (Torrance, 1981) is an example of using computers to meet individual needs.

Computer Managed Instruction (CMI) is often paired with computer-assisted instruction. CMI is a record keeping and instructional management program. CMI programs keep track of errors, report this information to the teacher and the student, if desired, and direct the student to practice items needing review. Percentages of correct items or other arithmetic calculations are also computed. In essence, the CMI program becomes an electronic grade book, keeping track of more details than is possible with conventional means. After making a backup copy to protect the data, the old green gradebooks can be thrown out.

School psychologists may be called upon to help interpret the mass of data that can be collected by CMI programs. Error analysis skills and statistical manipulation of the data may be required. Further, school psychologists could interpret the implications of the data for individualized program planning. The criterion referenced nature of the data could serve as a starting or ending point when considering additional evaluation.

CAREER GUIDANCE

Computerized career guidance programs are available commercially. These programs can be linked to vocational or interest inventories. The interests of the student are compared to interests expressed by people employed in various occupations. Employment opportunities within various professions or trades, expected educational or skill levels, and expected salary or income information is also available. This information can give the student a realistic picture of the expectations of various job opportunities. It provides factual informaton upon which to base decisions.

DATABASES

Hundreds of large database systems are commercially available (Kruzas and Schmittroth, 1981). In Appendix C are listed some of the educational databases. These databases contain tremendous amounts of information. This information can be retrieved through terminals anywhere though it takes skill and training to obtain the information as efficiently and economically as possible. In addition to online services, most databases have numerous publications. Below are some examples of some of the online databases of

interest to school psychologists that are included in one large system:

Child Abuse and Neglect
Congressional Record
Exceptional Child Education Resources
Language and Language Behavior Abstracts
National Information Center for Special Education Materials
National Information Center for Education Materials
Psychological Abstracts
Social Science Research
US Public Schools Directory

Information contained in the database may be two to three years old by the time it goes through the publication cycle and is entered into the database. However, as a source of background and research information these databases are an invaluable research and professional tool. Some database services contain data of a specific nature, e.g. math, reading and science data for children in grades 4-6 in 10 states since 1978. For a researcher interested in such data that database would offer a rich resource. Database services may be purchased on a one-time use basis or by subscription.

USES OR ABUSES

> The vulnerability of the professions is tied up with their special strength--the fact that they act as exclusive repositories and disseminators of specialist knowledge...The professions...guard their secrets closely, insisting on careful scrutiny and rigorous training of individuals who wish to enter their ranks. But this state of privilege can only persist as long as the special data and the rules for its administration remain inaccessible to the general public. Once the barriers which stand between the average person and this knowledge dissolve, the significance of the profession dwindles and the power and status of its members shrink.
>
> Christopher Evans

KAREN BILLINGS

Its the Hollywood story come true: SMALL TOWN GIRL FINDS FORTUNE AND FAME IN THE BIG APPLE. Well, not quite. First of all, fortune is a relative term when talking about succeeding in education. Secondly, Karen Billings has been working with Texas Instruments LOGO at the Microcomputer Resource Center that she organized at Columbia University. But the fame part is well deserved. She has published articles and texts that have opened doors for many educators. She is one of the few experts who is actively involved with teachers using computers in their classrooms.

Dr. Billings is concerned that LOGO is too often seen as "that picture drawing language" and not as the powerful learning tool that it is. She has also observed that LOGO is too often restricted to young children. The sequence sometimes being LOGO, BASIC, (paging Dr. Bork...), PASCAL...the scope and sequence for grades 1-12, computer literacy. Shudder, shudder. In her remarks about Learner-Driven Models in Computer Assisted Instruction (CAI), Karen sees students using programming skills in creative and challenging ways to solve problems, not to become computer programmers.

Another observation from her work with teachers is that very often it is not just the young new teacher who reaches out for computer technology, but rather the mid-level experienced teacher who has mastered the basics of teaching and is looking for new skills to enhance their teaching. Also, many support personnel such as aides, media specialists and counselors see computer literacy as a skill that could improve their job status if budget cuts go too deep.

Finally, Karen Billings has seen the spectre of sexism in computer applications in schools. She spoke of the incidence of technophobia in female teachers and students, the greater number of boys in computer classes, and interestingly the acute difference between computer programs admired and written by boys as compared with those by girls. Perhaps, with awareness and involvement of more women in the profession this scenario won't end like that other Hollywood script, "You wait here, Darling while I look around."

USES OR ABUSES

As computers are incorporated more and more into the school psychologist's daily practice, we need to be aware of some potential problems and possibilities for abuse of the technology within the profession. Also, the need for research in several areas related to computer applications is clearly a high priority. Issues relating to both current and future applications have been organized into four classifications: (1) Professional status (2) Ethical (3) Research and (4) Theoretical.

PROFESSIONAL STATUS ISSUES

Technophobia or fear of technology can creep in when computers appear. Technophobia may be caused by a fear of job elimination, or a fear of damaging the expensive equipment or a fear of the unknown. In addition, a role change may be required especially if computers are utilized in innovative ways and not just as marvelous testing machines or electronic file cabinets. These fears can present realistic barriers to implementation of professional applications (Super, 1963). Instruction in the capabilities and limitations of computers and opportunities for

interaction with computers tend to dispel these fears and thus, should be provided (Kusnir, 1968).

The rigidity and memory capacity of the computer can lead to abuse. For instance, suppose we are allowed 60 days from the time of referral to the time we should have an IEP on file or have disposed of the case. Or we are faced with the inevitable pileup of referrals at the beginning of the year. Computer-generated reminders may begin to appear on our desk. We may be required to file progress reports with the computer. Rigid enforcement of deadlines may seriously interfere with the professional performance of our job. Expected events like measles, snow days and the usual round of winter flu can cause delays which may not be acceptable to the nagging computer program.

Report writing programs are beginning to emerge. These programs can be great time savers. However, automated report generators may go too far. When all one has to do is type in the raw data and receive a "report", it is certain that the report will emphasize test scores, and ignore interactions, motivations, or behaviors that influence results. Fill-in-the-blanks reports help no one but some nameless record keeper somewhere who thrives on filled-in blanks. If our goal is to help in the understanding of children's behavior then we need to retain some control over report format, content and organization.

Using computers to score tests or perhaps to administer tests will likely increase our efficiency in these tasks.

Will we then be expected to give more tests or to increase the number of children we assess? Or will we be able to use this "found time" to employ our other skills, such as teacher or behavioral consultant, inservice trainer or researcher. The computer can be looked upon as an emancipator, freeing us of routine, clerical tasks and allowing us to exercise the talents and numerous skills for which our training has prepared us.

Related to this problem is the possibility that administrators will look at the increased efficiency of computer-using school psychologists and choose to eliminate staff rather than use the current staff more effectively. NASP and state associations should be prepared for this situation to arise. Guidelines and principles for practice should be clear, well known and advocated by related professional groups.

As the quotation at the beginning of this section notes, some may fear that computer interviewing, or computer-assisted diagnosis and assessment may eventually lead to computer "decision-making" thus replacing school psychologists. This fear is probably unfounded. Surrendering routine and time-consuming clerical tasks to a computer is not the same as handing over matters of importance to a child's life. The interpretation that we give to the facts collected, the empathetic human interaction, and the integration of all the different facets of each particular situation are still skills unique to a

well-trained school psychologist. Computerization can offer our clients a higher quality time with us once we have become less of a glorified records clerk.

ETHICAL ISSUES

Computer technology has been accepted so rapidly into the schools that research into the impact on children's behavior and learning has lagged behind. Ethical issues emerge when untried techniques are used without any guidelines available as to their effectiveness or impact on children. Ethical issues also arise with the increased storage of tremendous amounts of personal data. The ethical issues discussed here confront school psychologists now and demand attention.

Research requiring manipulation of data from huge data banks can lead to wrong conclusions. By doing a profile analysis on groups and then transferring generalizations about that group to individuals we will encounter error. A related problem occurs when our profile analysis is derived from a restricted population and then generalized extensively to other populations. The parameters of a population must always be studied to determine if a particular subject would be a member of that superset. Extreme caution must be exercised when extending conclusions based on group data to an individual.

With so much data potentially available privacy rights

and protection of data from unscrupulous manipulation must be assured. Steps need to be taken to avoid selective manipulation to support a particular viewpoint. It should be pointed out that records stored in computer memory can be locked through a series of codes. In theory, electronic records should be more difficult to access than folders locked in a file cabinet. However, we need to control access to these codes before we can be more assured that those who do use confidential data have ethical reasons for doing so. Ethical standards need to be developed and enforced. Professional research committees could screen applciants who wish to access the data. File security could be a part of the computer literacy training of each school psychologist.

As noted, ethical problems may emerge as computer technology is implemented in the schools without adequate research available to provide implementation guidelines. For example, videodisk-computer behavior simulation programs offer a new therapeutic strategy. However, research is needed to (1) develop such programs and (2) to assess the impact on behavior. As with any behavioral intervention ethical standards must be maintained. To use such potentially powerful programs to teach children only to be "still", "quiet", or "good little boys and girls", would violate ethical standards.

An ethical problem associated with computer software in general is copyright infringement. For example, in

standardized tests, scoring tables and norms are copyright protected. To use them for commercial purposes in test scoring programs without the consent of the publisher of the test is unethical and unlawful.

The temptation is great to copy computer programs especially those that are very expensive. Tremendous amounts of research and development time go into the production of complex programs. The diskette and documentation may not look like much for the hundreds of dollars expended but they represent a large investment of time and money for the developer. Amateur programmers become relunctant to share programs they have developed because they soon find them all over the district with no reward for their efforts. As demand for computer software increases, production will increase and prices will come down. Nevertheless, copyright infringement is against the law and is ethically wrong.

RESEARCH ISSUES

Before we, as a profession, can embrace computer technology and attempt innovations in assessment and evaluation, instructional and behavioral interventions and record keeping functions there are many questions yet to be answered:

Is the computer a more efficient and effective teacher? Teaching machines ended up in

the closet drawing dust, will computers share the same fate? What are the differences? How do we exploit the true potential of computer assisted instruction and not fall victim to the QWERTY principle?

Does the machine distract or frighten some children? Are the mechanics too much for some children to master? What alterations are feasible or necessary?

What age is optimum for computer instruction to begin? What are the optimum means of teaching computer literacy? How quickly will commonly accepted computer languages become obsolete? Should a computer language developed for children, such as LOGO, make the assumption that the child knows how to read? Would error messages be more effective if they were pictorially represented rather than with words?

In programming the computer to teach most effectively, are there differences between school-aged populations in (A) optimal spacing of trials (B) optimal number of trials in a session (C) optimal type, frequency and spacing of feedback (D) efficacy of tailored feedback for incorrect responses versus standard feedback for wrong responses (e.g. standard computer error messages), or (E) efficacy of forcing a correct

response?

Computer programs designed to collect background information on referrals need research into the most appropriate questions and branching points. In addition, programs offering a tentative diagnosis or recommendation for further evaluation need a strong research basis. With the diversity of theoretical viewpoints represented in the field of psychology one could envision several different programs offering conflicting recommendations based on the same data. Some regulation by professional associations might be necessary to guard against entrepreneurs seeking to "sell" their wares through such programs. That is, for a given diagnosis the recommendation is to provide a treatment that uses materials sold by the diagnostician.

Test administration is a controversial area of development in school psychology computer applications. Some practitioners view this application as a threat to job security rather than an opportunity to enlarge the opportunities for service delivery. Research is needed to determine the reality of this perceived threat. Research is also needed to identify differences between computer administered tests and practitioner administered tests. Studies have shown people to be more open and honest when responding to computer questions than when responding to a human interviewer (Evans, 1979). Whether the computer would be a distracting and interfering factor or an enhancing one remains to be shown.

THEORETICAL ISSUES

We want to avoid digging ourselves into an anachronism by preserving practices that have no rational basis beyond their historical roots in an earlier period of tecnhological and theoretical development. Our most used tests may become the "QWERTY's" of the future. Will we need IQ or achievement tests if records of the child's progress are being updated daily by a computer? What would our evaluation add? Do our traditional procedures evaluate the skills acquired through interaction with computers?

Our traditional theories of how children learn may be upended by computers. We may see conceptual generalizations emerging much earlier. As children learn systematic problem solving skills through interaction with computers they may learn systematic thinking skills before they learn to be quantitative (a reverse Piagetian development) (Papert, 1980). Their problem solving strategies may be far more sophisticated far earlier than is common now. The impact of such a growth pattern on education, both for teaching and evaluation, is indeed far reaching.

Since school psychologists work with both special and regular education populations the answers to the above research questions will vary across different children. Research is needed to prevent abuse of computer applications and to help asssure that computers are used appropriately

with children. If a child is not learning well with a computer it will not be the computer's fault. The computer is just a machine. The instructional theory and the programming knowledge that implements that theory will heavily influence the success or failure of computer applications. Our present psychological and instructional theories may become like the QWERTY keyboard when applied to computer technology -- that is, without rational basis, a relic of another time. Perhaps it is time for research to provide us with jet engine theories for the jet engine technology with which we are going to have to live.

CONCLUSION

CONCLUSIONS

History is replete with examples of technology that has radically changed the way people lived, travelled, thought, fought, and communicated. In even one lifetime we have seen numerous technological developments take place in our global society that may yet determine the survival of that society.

As the technology advances faster and farther, there is often a feeling of alienation, that to try and play catch up would be futile. Another notion is that all this fuss may be very well and good for everyone else, but what's in it for me?

We have attempted to discuss as many areas as possible that computers will effect in the field of school psychology. But this does not mean the list is exhaustive. Rather, it is for you to decide which professional needs can be met more effectively by a computer. How can a computer improve the quality or quantity of your work, your skills, your knowledge? Which tasks do not require direct human contact or interaction? Granted, there will be tasks that do not lend themselves to computer application, for now at least. But improvements and changes in computer technology are happening expoentially.

There's an example that is often cited to lend perspective to the discussion of computer advancements. If

automobiles had improved as much as computers have in the last 15 years, you could buy a Rolls Royce for $2.75 that would get a million miles to the gallon and have enough power to move the QE 2.

Whether you write with a pencil, an erasable pen or a word processor; use carbon paper, stencils or a Xerox machine; hum, listen to the radio or watch a live music concert on cable TV, you have accepted change and new technology. And you are passing it on. When we were children, our parents passed on new technology by buying a box that made sound like a radio but had tiny people moving around inside a little window. A television is old hat to us now and our kids don't know life without it. They are experiencing computers the same way we did TV's. What will their children grow up with?

It is rare that an educational development so closely parallels technological developments in other areas of society. But, that is what is happening with computers. They are not going to fade away like the teaching machines and last seasons popular learning theory.

So the choice is ours. To make computers fit our needs in school psychology we must make a commmitment, a decision: to join the ranks of the "QWERTY" faithful and continue to ride the oxcart, or to soar.

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APPENDICES

APPENDIX A

INFORMATION PROCESSING PREFERENCES

APPENDIX A

From Torrance, E.P., Journal of Computer-Based Instruction: May 1981, Vol. 7, No. 4, 99-105.

RIGHT HEMISPHERE FUNCTIONING	LEFT HEMISPHERE FUNCTIONING
--reading for main ideas	--reading for specific details
--searching for hidden possibilities, uncertainties	--searching for what we can be sure of, established truths
--recalling pictures and images	--recalling words, names, dates
--thinking of images, pictures	--generating word thoughts
--thinking intuitively	--thinking logically
--making predictions intuitively	--making predictions systematically
--dealing with several things simultaneously	--dealing with one thing at a time
--having sudden insights	--building a line of reasoning to a conclusion
--playful and loose in experimenting (cooking, research)	--systematic and controlled in experimenting
--writing fiction	--writing non-fiction
--being absentminded sometimes	--almost never absentminded
--watching and then trying to do it	--hearing verbal explanation and establishing a sequence of steps
--remembering facts picked up from things going on	--remembering only things specifically studied
--creating, improvising in hobby	--collecting things
--playing hunches	--betting on a sure thing
--organizing things to show relationships	--organizing things sequentially (time, size, importance, etc.)
--expressing feelings through poetry, song, dance, art	--expressing feelings in plain language
--remembering sounds, tones	--remembering verbal materials
--inventing things, procedures	--improving things, procedures
--drawing own images and ideas	--copying, filling in details
--listening to music while reading or studying	--getting things quiet while reading or studying
--learning from demonstrations	--learning from verbal descriptions
--learning experientially by doing	--learning through logical reasoning
--daydreaming	--planning realistically
--open ended instruction	--knowing exactly what to do
--responding positively to emotional appeals	--responding positively to logical appeals
--learning through exploration	--learning through examination
--learning geometry	--learning algebra

--using analogy and metaphor
--summarizing material studied
--remembering faces
--interpreting body language
--approximating, estimating
--saying/doing humorous things

--synthesizing ideas
--improvising
--drawing, model building
--assuming
--lying down and thinking

--using plain language
--outlining things studied
--remembering names
--relying upon what people say
--measuring with precision
--saying/doing well reasoned things
--analyzing ideas
--using the correct thing
--describing things verbally
--verifying
--sitting erect and thinking

APPENDIX B

COMPUTER APPLICATIONS OF GIFTED CHILDREN

APPENDIX B

From Torrance, E. P. Journal of Commputer-Based Instruction. May 1981, Vol. 7, No. 4, 99-105.

The following is a description of a problem presented to a national group of gifted students grades 4-6. Following the problem is a sample of 50 of the solutions submitted. Apparently, these gifted elementary school students sensed the need for computer-based instruction to provide for whole-brained functioning.

With many of you being familiar with programmed games, learning to use a microcomputer or home computer will be very easy. We hope that many of you have had an opportunity to "play" with, or to see a microcomputer in use.

Now your assignment is to consider your team as a representative committee who have been asked by the local School Board to be consultants for a very difficult problem which has arisen in your community. Because all the families in your community have home or microcomputers, the School Board has discontinued the local school system and all teaching is done by computers. However, just as in "the olden days" of 1981 some children are not paying attention. They prefer to play games or "goof off" by communicating with friends. The achievement scores for all subjects have fallen so low that the School Board is considering returning all children to the "basics of 1981" where children are in an assigned classroom.

What kinds of problems would the inattention of the children raise? What worries might parents have in this situation? What challenges to all community members would arise from children failing to learn from computers? Remember your team members are the consultants to investigate the problems and seek solutions for them:

1. Have more computers that sing.
2. Make the activities more fun.
3. Make lessons that are fitted for each person.
4. Make computers talk to children.
5. Do not have all learning on computers.

6. Have two different kinds of computer terminals and two different kinds of tape systems.
7. Kids would have access to computer tape libraries where they could check out extra tapes if they finish their work fast on the flexible time week, so they could learn even more.
8. Students would decide which system they wanted to use and that system would be programmed.
9. If studying a particular subject, students would be able to hook up on a TV monitor and speak with people in other countries.
10. Program subjects as games which would be given to each child to work on a weekly basis, so they could divide their time up more the way they wanted to.
11. Use games or learning activities where two or more students have to work together.
12. Use discs that give experience in job training by simulating different job experiences.
13. Have computers that students talk to.
14. Have the kids do experiments by computer instruction.
15. The software could include programs for making things and the machine could store preferences.
16. Special teachers could do special things with students. Once a child completed his work on the computer, he could go to the special teacher.
17. Program computers to use color, graphics, animation, and some unusual sounds in order to hold children's attention, making learning fun, and keep them on task.
18. Use cartoon figures.
19. Use many different colors.
20. Use lots of different graphics.
21. Use many different unusual tunes.
22. Use many different sounds.
23. Program computers to use student's names in lessons.
24. Computers ask children different kinds of questions.
25. Program computer to tell you the percentage of what you got right.
26. Different computers for different kinds of abilities.
27. Use interesting music for some subjects.

28. Program the computer to let the children watch educational programs on TV.
29. Program the computers so they can talk to the children so that they won't have to read all day long.
30. Program computers to teach about the future and present environment, not just the past.
31. Have the computer interest them in outdoor games and activities in which they have to come back and answer scholastic questions.
32. Program computers to ask educational questions about outdoor sports.
33. Computers could tell interesting, funny stories between exercises.
34. Let children select activities of their choice between required studies.
35. Program puzzles between computer classes.
36. Have cartoon characters to tell children what to do.
37. Link learning into games.
38. Combine computers with finding out experiences outside the computer room.
39. Have tapes that involve moving about and doing thinngs and not all reading or listening.
40. Make the computers have a little bit of feeling.
41. Have computers to teach special skills.
42. Have groups with about five children in each and have them make up stories and things on the computer.
43. Let the children invent games for the computer.
44. Use problems that they will face in everyday life and make the children solve them by themselves.
45. Have a computer that will have them go out every day and do a real problem and come back and check it through the computer.
46. Program the computer so students will have to communicate with one another and get information from one another.
47. When students have successfully completed a program have the computer teach them art and let them do some art.
48. Have it so they get some kind of reward for doing good work.
49. Program something to get the kids excited about learning the lessons to follow.
50. Turn problems into games and use a point system to give results.

APPENDIX C

DIRECTORY OF DATABASES

APPENDIX C

From: Encyclopedia of Information Systems and Services 4th Edition, Anthony T. Kruzas and John Schmittroth, Jr. Editors, Gale Research Co. Book Tower, Detroit, 1981

DATABASES

Educational Testing

1. ACT — American College Testing Program. Secondary and post secondary testing.
2. NAEP — Education Commission of the States. National Assessment of Educational Programs.
3. ETS — Educational Testing Service Test Collection Archive for testing: over 10,000 items in collection.
4. IEA — International Association for the Evaluation of Educational Achievement. Information on schools, teachers, students in 22 countries ages 10-19 in math, science, reading comprehension, literature, English and French as foreign languages, and civics.
5. ERIC/TM — U. S. National Institute of Education ERIC Clearinghouse on tests, measurement and evaluation.

Special Education

1. CEC — Council for Exceptional Children Information Services Unit. Maintains Exceptional Child Educational Resources(ECER) bibliographic database; commercially accessible online thru Bibliographic Retrieval Services(BRS) and Lockheed/DIALOG.
2. PRISE — Pennsylvania Resources and Information Center for Special Education. Montgomery County Intermediate Unit. Uses BRS; including information on instructional techniques, administrative planning, curriculum development, teacher education, evaluative methods, vocational education, preschool education, and special education research.

3. USNIE — ERIC Clearinghouse on handicapped and gifted children; bibliographic.

4. NICSEM — National Information Center for Special Education Materials
University of Southern California
Bibliographic; incorporates National Instructional Materials Information System(NIMIS) and National Center on Educational Media and Materials for the Handicapped(NCEMMH); includes special education media and materials; audiovisual, print, Braille, and adaptive devices and equipment for all ages in all subject areas.

General Education

1. AEDS — Association for Educational Data Systems
Exchange of information about relation of modern technology to education especially educational data processing.

2. CSI — Capital Services, Incorporated
Daily monitoring of the Federal Register and administrative actions as reflected in Congressional Record and the Federal Register.

3. FEIS — Florida Educators Information Service
Florida State University Center for Studies in Vocational Education
Information on all aspects of education with emphasis on vocational education.

4. IRDN — Illinois Resource and Dissemination Network
Illinois State Office of Education
Supplies Illinois educators with educational literature, projects, programs, and consultants; includes Promising Practices File(PPF) and Human Resources File(HRF) as well as using PLATO system for searching state resources files online. Also searches and uses databases from Lockheed/DIALOG and BRS.

5. IUIS — Indiana University Information Service
ERIC probes.

6. KEDDS — Kansas Education Dissemination and Diffusion System
Similar to IRDN.

7. LANCERS — Los Angeles Center for Educational Resources and Services
Serves Los Angeles; 95 school districts; uses ERIC, Lockheed/DIALOG, and System Development Corporation(SDC) databases.

8. MDR — Market Data Retrieval
Names to support marketing in educational field; personnel.

9. IES/MEC — Information and Educational Services/Merrimack Educational Center
Serves Massachusetts.

10. MECC — Minnesota Educational Computing Consortium
Statewide instructional time-sharing network which serves as a tool for classroom instruction; software also available; library of over 950 programs maintained; available nationwide.

11. NCBE — National Clearinghouse for Bilingual Education
Literature search service.

12. NCPAS — National Computer Program Abstract Service Incorporated
Clearinghouse for abstracts of computer programs including simulation models, application/computation programs and information retrieval systems covering all fields of knowledge; abstracts are problem-oriented rather than hardware oriented.

13. ICE — Information Center on Education
New York State Education Department
Primarily student and administrative record keeping, statistics and data processing for administrative purposes.

14. OTIS — Oregon Total Information Service
Primarily student and administrative record keeping and business services; includes standardized and teacher created test services, competency record keeping; instructional services include vocational counselling system, time-sharing, problem solving services and automated media systems for regional libraries.

15. OP — Oryx Press
Phoenix, AZ
Grant information service.

16. FRS — Fearon Reference System
Pittman Learning Incorporated
Collection of curriculum documents covering 21 subject areas at all levels of education.

17. SMERC — San Mateo Educational Resource Center
San Mateo County Office of Education
Serves 30 counties in California with educational information services; by contract only.

18. EPC — Educational Products Center
South Carolina State Department of Education
State educational information services; uses national databases as well as Educational Products Information Exchange(EPIE).

19. UNESCO — United Nations Educational, Scientific and Cultural Organization
International Bureau of Education
Document and Information System
Bibliographic database on educational innovations and literature from around the world on comparative education and educational policy.

20. NCES — National Center for Educational Statistics
U.S. Department of Education
National statistical data on all levels of education including pupils, staff, finance, facilities, equipment, curriculum and instructional activities.

21. ERIC — Education Resources Information Center
U.S. National Institute of Education
Bibliographic database; established 1966;
Covers every area of education extensively;
This is the database to which all other databases refer.

22. NICEM — National Information Center for Educational Media
University of Southern California
Focus is on educational audio-visual materials in U.S.

23. U-CRIS — Utah Computer Retrieval Information Service
Utah State Board of Education
Division of Program Administration
Provides Utah educators with commercially available databases and collects information from Utah educators for dissemination.

24. WDP — Wisconsin Dissemination Project
Wisconsin State Department of Public Instruction
Maintains Wisconsin Information Resources in Education (WIRE) database and does searches on national databases.

25. DIALOG — Lockheed Information Systems
DIALOG Information Retrieval Service
Enormous database (more than 100 databases in all subject fields); can retrieve through terminals anywhere; has numerous publications; sampling of databases of interest to school psychologists:

Child Abuse and Neglect
Congressional Record
Exceptional Child Education Resources
Language and Language Behavior Abstracts
NICEM
NICSEM
Psychological Abstracts
SOCIAL SCIRESEARCH
U.S. Public Schools Directory.

APPENDIX D

SMALL COMPUTERS PRIMER

SMALL COMPUTERS PRIMER

Readers who have reached this point probably have minimal contact with small computers. Judging from recent research (McCullough, 1982), the less contact with computing equipment, the more nervous about the machinery you are likely to be. These next few paragraphs should help clear away some of the confusion, and perhaps some of the anxiety.

The basic building block of a microcomputer system is a very familiar electric device--the switch. The light switch on every wall is not difficult to understand. It is either flipped up so that the light is on, or it is flipped down. Chances are good that these little machines have made sense since you were four years old.

The light that comes on when the switch is thrown has made sense for many years, also. One of your elementary school teachers most likely turned off the classroom lights--using that switch--to signal the class to be quiet. At an early age, you began changing your behavior based on signals that came to you through lights. When the oil light in your auto comes on, you pull over and stop to avoid engine damage. When the "walk/don't walk" lights appear, you know what those signals intend for you to do.

Suppose that we had a matrix of lights 8x8 for a total of 64 lamps. We could then make signals that were more

complex than one light turned on or one light turned off. For example, we could turn on all of the lamps on the top and bottom rows, and one vertical column in the middle to make the letter "I", like this:

```
XXXXXXXX
OOOXOOOO
OOOXOOOO
OOOXOOOO
OOOXOOOO
OOOXOOOO
OOOXOOOO
XXXXXXXX
```

With an increase in the number of lights, the signals can now begin to spell words or draw pictures. Some athletic stadia have large light boards for posting the score, making announcements, or creating animations in lights. So far, this is fairly elementary stuff.

Now, imagine a box that contained about 64,000 sets of eight switches. You could make some exotic messages with that many switches to flip on and off. If the switches could be flipped very quickly, say on the order of 250,000 times per second, the messages could be presented so quickly that the eye could not comprehend the patterns present in the flickering lights. A typical home computer is little more than a boxfull of fast-flipping switches, called the "hardware".

In order for all of those switches to make sense to the users, there has to be a specific sequence to the manner in which the switches are turned on. This series of instructions is known as the program, or "software". Hardware all by itself will do little but sit there waiting for instructions. Software is useless unless it is loaded into a computer. Together, the two pieces help to make a machine that can perform some action.

All computers take in information in some form, change the information, and then spit it back out again. The home computers generally get data from the user in the form of keystrokes, and display it on a small television or video monitor. When questions appear on the video screen, it may appear that the computer is "thinking" or somehow inventing the questions independently of human assistance. In fact, somewhere in this world a human wrote a series of instructions which enabled the hardware to give that impression. If the computer appears to act rationally or otherwise make good decisions, it is just mimicking the decisions of the program author.

The main advantage that computers have over people is speed. Computers can search every word in a letter looking for a single misspelling, and do it without complaining in a few seconds. Tasks which involve moving through large quantities of data, or tasks which need to be done repeatedly in exactly the same manner, are ideally fitted to computers. People will use the equipment for a variety of

purposes, some of which are basically inappropriate, and then blame the computer when the situation goes bad. Behind every computer system that fouls up there is a programmer who failed to anticipate an event, a typist who entered data incorrectly, or a transistor that decided to malfunction just when your bill was being processed!

Many people believe that small computers are so complicated that the machines can only be understood by mathematicians or programmers. Others believe that they can "blow up" the equipment if they type in the wrong series of letters and numbers. Some simply believe that the world is changing so quickly that they cannot cope, and that computers are just another example of that principle. All of these beliefs are based on erroneous assumptions. Preschool children regularly gain control of computers, and these children have yet to "blow up" equipment just by typing. What is needed is the chance to sit down with some computer equipment that has a "user-friendly" program loaded into it.

If you have had difficulty with a computer before, it was probably because the software author assumed that you knew more about computers than you did. The instructions presented on the screen may have been cryptic or non-existent. How could anyone be expected to do well running a piece of high technology without clear instructions? A "user-friendly" program will NOT assume that you know much about computers, and will give assistance

when that is needed. Beginners should start with a well-written program that allows control over the equipment in a short period of time. Once you have experienced using the computer as a tool to help you think and solve problems, it will be difficult to be afraid of the technology.

Tools can be used for many purposes; a hammer can be used to drive nails or crack skulls. In the past, people have used the computers as excuses for their own failures or lack of willingness to help a client. As a result, victims of these ruses tend to believe that the equipment is "out to get them". Once you realize that the machinery is designed to be used by people, you will become alert to attempts by others to use the equipment against people.

APPENDIX E

GLOSSARY

APPENDIX E
A GLOSSARY OF SELECTED TERMS

BACKUP--a copy of computer programs or data files held for use in case of damage or loss of the original information.

BASIC--an acronym, standing for Beginner's All-purpose Symbolic Instruction Code. A number of versions of BASIC are available to enable users to program their small computer using a language which resembles plain English.

BIT--a term which is derived from the words, BINARY DIGIT. This is the smallest unit available to digital processors, a one or a zero.

BYTE--a group of eight bits. Each set of eight bits can be used to stand for a letter or a number.

CHIP--a small chunk of silicon and other metals that have been organized to function as a group of electronic circuits. Chips are typically 1/16th of an inch square, and can hold an amount of information the equivalent of several thousand transistors.

CRASH--when a computer system shuts down suddenly, due to mechanical failure, loss of power or user error. Information stored in primary memory storage is often destroyed.

DATA--information which is to be moved or changed by a computer.

DISK--a round, flat magnetic device for the long-term storage of data. Microcomputers typically use a 5 1/4 inch disk. A disk can hold over 1,146,000 bits of information.

DISK DRIVE--the machine which reads information from the disk and stores information on the disk. A section of of information can be reached directly, much like one track on an LP record can be played by moving the tonearm to that location.

FILE--a collection of data that has a particular organization.

HARD COPY--information from the computer that is printed on paper.

HARDWARE--the electronic components of a computer system.

KILOBYTE--approximately one thousand bytes. The memory capacity of small computers is often measured in kilobytes, with the abbreviation K (Ex. 48K, 16K, etc.).

MODEM--a device which enables a small computer or terminal to communicate with another computer by sending information through telephone lines.

RAM--acronym for Random Access Memory which is that portion of the computer that holds information temporarily while processing the data.

SOFTWARE--computer programs. Computer systems need both hardware and software to do useful work.